WATER SUPPLY STUDY FOR AQUA ILLINOIS SYSTEM

AT UNIVERSITY PARK, IL

March 18, 2013

2709 McGraw Drive ▪ Bloomington, IL 61704
Phone 309-663-8435 ▪ Fax 309-663-1571

WATER SUPPLY STUDY FOR AQUA ILLINOIS SYSTEM
At University Park
March 18, 2013

Table of Contents

EXECUTIVE SUMMARY

Significant population growth has been projected for the southeast portion of Will County by the Chicago Metropolitan Agency for Planning (CMAP). This includes the area surrounding the proposed South Suburban Airport (SSA) and the Illiana Expressway. No doubt the development of these two infrastructure projects would cause dramatic growth in the area. Governor's State University in University Park is also planning for growth in their student population with the addition of on campus student housing. Aqua Illinois is in a favorable position to serve the new and existing customers in the area with a supply of softened, iron-free water. The following report has concluded that the most economical alternative for supplying this water is a pipeline extending from Aqua Illinois' system in Illinois Diversatech near Manteno, Illinois.

Alternative water supplies considered were:

- Ground water supply and treatment
- Lake Michigan water supply.

The ground water supply in the area is fractured dolomite with limited capacity to supply the anticipated growth. Also, water from this aquifer has water quality issues related to aesthetics due to high levels of iron and hardness. Local officials, and Aqua Illinois customers in University Park have complained to the Illinois Commerce Commission (ICC) over these issues. In order to implement the ground water supply alternative, a well supply and water softening plant, owned and operated by Aqua Illinois, in University Park would be proposed. In the following report, the cost of this alternative is shown to be more costly than the pipeline alternative.

The Lake Michigan water supply is also a more costly alternative due to the distance required to connect to a source with adequate allocation: the City of Chicago. The negotiations required to implement this alternative would be difficult. Moreover, the uncertainty of future allocations and price increases would make it difficult to plan for future growth.

This study has shown that the pipeline alternative is the most economical water supply alternative for the study area. The Kankakee River has ample capacity and has been proposed in the past by the Illinois State Water Survey as a potential source of water for Northeastern Illinois, including Will County. The water treatment plant in Kankakee has intakes to the Kankakee River, and will be capable of providing softened iron-free water to the study area.

Five proposed routes are under consideration for the pipeline. The two favored routes for the pipeline are:

- Illinois Route 50, and
- Will Center Road (County Highway 10)

A water transmission main along Illinois Route 50 could potentially cost less but the restricted ROW and restoration costs to cross through the Villages of Peotone and Monee could drive these costs upward. Essentially, these are unforeseen costs that can only be accurately assessed by discussion with highway and local officials. This would occur if Aqua decided to pursue this route. There would be a negative impact on the residential and business areas of these communities. Aqua Illinois may not want to incur possible ill will of potential future customers by pursuing this route.

The second route, following Will Center Road, is a longer route by three miles. There are also 73 parcels to cross along this route versus 10 parcels to cross along the route following Illinois Route 50. Thus, there are also added easement acquisition costs with the Will Center Route and greater chance for project delay. On the plus side, the construction would be in open areas for reduced restoration costs and impact on the public. In addition, Will Center Road is favorably located between Peotone and Beecher and does not interfere with the service territories of the two communities.

The recommended pipeline material is ductile iron. The selected size depends on the capacity Aqua Illinois warrants as justified to provide for future growth. This study has projected flow rates and prospective customers to be served using a 20 year design period. From this information three alternative pipeline sizes have been proposed as shown in the following table.

Pipeline Size, in.	Flow Rates		No. of Customers[1]	Cost $ millions[2]
	Max, mgd	Avg, mgd		
24”	10.4	3.4	9,900	$16.4M
30”	14.1	4.7	13,400	$18.5M
36”/30”[3]	18.6	6.2	17,700	$21.3M

[1] Number of additional single family residences

[2] Cost for water main construction, engineering design and easement acquisition. Assuming ductile iron pipe and the selected route is Will Center Road.

[3] 36” size to Peotone and 30” the remaining distance to University Park

The number of customers presented above represents the low, medium and high projections for the study area for a 20 year design period, over and above the number of current customers in University Park.

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

Aqua Illinois wishes to supply its customers in University Park, IL, both existing customers and future customers acquired with expected growth in the service territory, with softened and iron-free water. This is in response to customer demands and anticipated growth in the area. Customers in the University Park Division have requested higher quality water through calls to the company and contacts with the Illinois Commerce Commission (ICC). They have expressed a strong desire for a softened water supply. These requests have been reiterated by various officials through University Park Board meeting minutes.

Growth in the University Park service territory would be influenced by two potential sources. One potential source would be the South Suburban Airport (SSA) which would be located several miles south of University Park as shown in Figure 9 in the Appendix of this report. A second potential source of growth is the Illiana Expressway, which would connect I-55 in Illinois with I-65 in Indiana. The proposed corridor for the Illiana Expressway would cross Will County just south of Peotone and Beecher.

An existing customer in the University Park expected to generate considerable growth is Governor's State University (GSU). GSU has a plan to add on-campus housing. In Phase I of the plan, scheduled to be completed in 2014, GSU will add 296 beds of on-campus housing.

With a quality service of water in the area, Aqua Illinois would be in a favorable position for adding new customers. Realizing this need for water quality and potential growth, Aqua Illinois has commissioned this study of providing a source of quality water to the University Park area. The following report investigates the following alternatives for providing this water:

1. Water main from the Kankakee system at Illinois Diversatech in Manteno, IL.
2. Ground water supply and water softening plant in University Park.
3. Treated Lake Michigan water supply.

Along with the water main alternative study, this report discusses the feasible routes and evaluates the two most economical routes for the water main. Projections are made for the water demands of several communities in the study area. Based on these projections, three sizes for the water main are proposed. Construction cost estimates are made for three pipe materials for each size of main: ductile iron, high density polyethylene (HDPE) and polyvinyl chloride (PVC).

II. BACKGROUND INFORMATION

A. Population Growth of Area

As will be shown in this report, the population of the study area is projected to increase dramatically. This is based on projections by the Chicago Metropolitan Agency for Planning. The growth rate recently has been affected negatively by the downturn in the economy and the housing market. This should change when the economy rebounds. Also, growth will be influenced positively by the construction of the South Suburban Airport and the Illiana Expressway, which are both in the planning stages. Another positive factor is the growth at Governor's State University as discussed above.

B. Ground Water Supply in the Study Area

University Park, as well as most communities in eastern Will County, utilizes the Silurian Dolomite Aquifer for its water supply. Typically the wells in the area, which are open to the Silurian Dolomite, are 500 feet deep and have a capacity of 500 gpm each as reported by the Illinois State Water Survey (ISWS)[1]. University Park currently has four active wells and one standby well which are open to the Silurian Dolomite.

Shallow sand and gravel aquifers underlay about 50% of the area. Typically, these wells have a capacity of 50 gpm and are 100 feet in depth. The capacity of these wells is impractical for developing a municipal water supply.

Deep sandstone aquifers underlay this area. Wells in these aquifers are typically 1800 feet deep making them expensive to develop. These wells have adequate capacity for a municipal supply; however, as reported by ISWS the radioactivity in the water exceeds the EPA drinking water standard over a significant portion of Northeastern Illinois. This fact leads to significant water treatment costs, or for communities in Will County with this problem to seek alternative water supplies such as water from Lake Michigan or the Kankakee River.

The Silurian Dolomite potential yield has been estimated by the ISWS at 4.8 million gallons per day (mgd) for Monee Township, where the Villages of University Park and Monee are located. This figure is considered to be the 180 day safe yield with zero recharge of the aquifer.

The current average water demand for Monee Township, including Aqua Illinois' system in University Park and the Village of Monee's system, is estimated to be 2.1 mgd. In 20 years, based on projections in this report, the estimated demand for Monee Township is 3.8 mgd. For the foreseeable future, this aquifer should be adequate to provide for the water demand of these communities. However, at some point in the future, the communities need to supplement their Silurian Dolomite well supplies with an additional water supply source.

[1]Krishan Singh and J. Rodger Adams, "Adequacy and Economics of Water Supply in Northeastern Illinois," ISWS CR-229, May 1980.

C. Quality of Community Water Supplies in the Study Area

The water quality of the wells open in the Silurian Dolomite is typified by the following test results of the Aqua Illinois wells in University Park:

TABLE 1

Aqua Illinois Incorporated
University Park
Well Water Quality[2]

	Wells			
	No 1	No 2	No 3	No 6
Alkalinity, mg/l as $CaC0^3$	ND	418	297	246
Chloride, mg/l	3.9	1.0	1.5	1.7
Fluoride, mg/l	0.99	0.85	4.0	0.47
Hardness, mg/l as $CaCo^3$	410	416	530	597
Ammonia, mg/l as N	0.13	<0.1	0.42	0.77
Nitrate-Nitrite, mg/l as $N0_3$	<0.1	<0.1	<0.1	<0.1
Sulfate, mg/l	34	13.8	290	297
Total dissolved solids, mg/l	405	476	701	648
Silca, mg/l	17.1	16.0	11.7	12.4
Calcium, mg/l	90	2	120	160
Magnesium, mg/l	45	48	56	51
Manganese, mg/l	0.023	<0.015	0.015	<0.015
Sodium, mg/l	10	11	36	29
Lead mcg/l	<5	<5	<5	<5
Radon, pCi/l	200	150	130	290
Gross Alpha, pCi/l	< 4	< 5	< 4	ND
Iron mg/l	0.45	0.52	1.0	0.68

ND – No Data

The above test results indicate hard water exceeding a desirable level of 150 to 200 mg/l for softened water. Iron levels exceed the recommended limit of 0.3 mg/l. Polyphosphate is added by Aqua Illinois to the well water to sequester, or hold the iron in solution thereby preventing red water problems from occurring in the distribution system. Ammonia is also present in two of the wells. Ammonia combines with chlorine, which is added to disinfect the water. This combined chlorine residual is beneficial for extending the life of the disinfectant in the water in the distribution system. Aqua Illinois' long term plan is to add ammonia at all the wells to produce a constant combined chlorine residual in the system.

[2]NIES Engineering, Inc., "University Park Disinfection and Operation Study," May, 2004.

D. Aqua Illinois Kankakee System

The Aqua Illinois system in Kankakee is a source of softened, iron-free water that could be developed for the study area. The Kankakee System extends to the Illinois Diversatech, which is just outside the Village of Manteno Illinois. At Illinois Diversatech, which is about 20 miles from University Park, Aqua Illinois has a three million gallon (mg) ground storage tank and two pump stations. One pump station serves the Village of Manteno and the other pump station serves the Village of Grant Park.

The 3 mg tank at Illinois Diversatech is supplied with a 16 inch main from Aqua Illinois' system to the south in Bradley, IL. Aqua Illinois' long range plan is to parallel or replace this main with a larger main in order to have the capability to provide more water to the north.

The source of the water is the Kankakee River. Aqua Illinois has a water treatment plant in Kankakee, IL, which takes water from the Kankakee River, treats it and then pumps it into the regional distribution system. Treatment consists of clarification softening, filtration, fluoridation and combined chlorine disinfection.

The Kankakee River is a reliable, large capacity source of water for the area. The ISWS has documented the flow in the river using gaging stations along the river. ISWS characterizes the low flow in the river using a statistical measure: the 7-day, 10-year low flow, $Q_{7,10}$. They have determined that the Kankakee River has a $Q_{7,10}$ just downstream of Aqua Illinois' water treatment plant intake of 451 cubic feet per second (cfs). This is equivalent to 291 mgd. For comparison, as discussed below, the maximum daily demand for the area around University Park for the 20 yr. study period is 7 to 12 mgd. As shown, the Kankakee River has ample capacity as a water supply.

E. Lake Michigan Water Supply

The Illinois Lake Michigan Water Allocation Program was developed to manage Illinois' diversion of Lake Michigan water in response to a 1967 Supreme Court Decree limiting Illinois' diversion to 3,200 cfs. The use of Lake Michigan water for domestic use is considered a diversion under this program. The diversion of Lake Michigan water for domestic use, defined as a public water supply is given priority over other forms of diversion. The program is implemented by the IDNR/AWR's Lake Michigan Management Section using the Department Part 3730 Rules "Allocation of Water from Lake Michigan".

The Illinois Allocation program consists of the following key elements:

- Active public participation program
- Identification of available water supply resources
- A long-range water demand forecasting methodology
- Formal allocation hearings on all requests
- Issuance of an Allocation Order
- Ongoing monitoring of water use and consumption by all permitted
- Formal process to make adjustments in allocation

The existing usage for the University Park Water System is 1.5 mgd. The ultimate need for 20-year projected growth for the surrounding township is 4 mgd. The existing aquifer supplying water to the University Park Water System Area has a limited maximum capacity of 4.8 mgd.

A study of the remaining Lake Michigan Water Allocation for the water systems surrounding University Park is shown in the following table:

Closest Municipalities with Lake Michigan Water Supply			
Municipality	**Allocation (mgd)**	**Net Annual Dumpage (mgd)**	**Distance**
Chicago Heights	5.844	5.745	9.4
Matteson	2.286	1.687	5.3
Olympia Fields	0.841	0.560	6.1
Flossmoor	1.195	1.175	8.0
Calumet City	4.912	3.948	23.3
Homewood	1.986	1.595	10.3
Lansing	3.942	3.226	18.5
Harvey	4.038	3.832	16.6
Chicago	596.282	479.032	19.3

This table indicates that the only system with enough excess capacity in their Lake Michigan Water Allocation to provide for the future water needs of University Park is the City of Chicago. The process of acquiring City of Chicago lake water is quite complex. There were numerous communities between University Park and the City of Chicago that receive Lake Michigan water. A Chicago water supply connection for University Park would invariably require connection to "upstream" municipal systems that exist between Chicago and University Park. It would require an engineering analysis and discussions with upstream communities about their water supply capacity and necessary system upgrades that are needed to be addressed along with each communities' policy positions with regard to distributing the water. The research also would include an examination of the many factors affiliated with the Chicago Lake Michigan Water. The cost of purchasing Lake Michigan water, building miles of transmission mains, reinforcing upstream community systems, and the ongoing maintenance expenditures to operate a completed system would need to be factored into the final analysis. It is approximately 19.3 miles to the south side of Chicago through highly urbanized areas. AQUA would be a passive party to water rate increases occurring in the municipalities upstream from University Park. The complex political and technical nature of acquiring Lake Michigan water from the City of Chicago and the anticipated high construction costs make this an undesired option to supplement the University Park water supply.

F. Water Treatment Plant at University Park

The feasibility of constructing a water treatment plant in University Park to provide softened iron-free water has been investigated in this report. The plant would be constructed as an alternative to the transmission main from the Aqua Illinois System in Illinois Diversatech in Manteno. The basis of design for the plant is presented in Exhibit 1 in the Appendix. The plant would be designed for a projected population of 7,600 in University Park with a design treatment rate of 4,000 gpm. The plant would be located west of Well 7 on 7.2 acres of land currently owned by Aqua Illinois. Treatment would consist of lime softening using upflow clarifiers. Other treatment processes would include recarbonation, gravity filtration with dual media (anthracite and sand) filters, chlorination, fluoridation, and aqueous ammonia chemical feed for combined chlorination.

The well supply for the water treatment plant needs to have a firm pump capacity of 4,000 gpm with the largest capacity well out of service. The water plant would be located in the residential area where four existing wells could be utilized with the following capacity:

Existing Residential Well No.	Capacity, gpm
No. 1	600 gpm
No. 2	950 gpm
No. 5	1,000 gpm
No. 7	700 gpm
Total	3,250 gpm

Currently, Well No. 5 does not have pump equipment installed. Well No. 7 is on standby and typically is not used.

In order to achieve a firm capacity of 4,000 gpm with Well No. 5, the future largest capacity well, out of service, 1750 gpm of additional well capacity is needed. At an average developed capacity of 600 gpm per well, three additional wells with a capacity of 600 gpm each would be required. In the industrial park, there are two existing wells: Well No. 3 with a capacity of 720 gpm and Well No. 6 with a capacity of 600 gpm. In order to connect these two wells to the water treatment plant in the residential area, 3 miles of 12 in. main would be required. This study estimates that the development of a well field in the residential section with three additional wells would be more economical from a construction and operation standpoint.

The construction costs for the water treatment plant, three additional wells and raw water main have been estimated. Table 51 in the Appendix shows the water treatment plant costs with a total construction cost of $28 million dollars. Table 52 in the Appendix shows the construction cost of the new wells and raw water main with a total construction cost of $7 million dollars. For the water treatment plant alternative, the total construction cost is $35 million dollars. This cost is much higher than any of the water main alternatives proposed to serve University Park as discussed in Section VI of this report. The alternative of constructing a lime softening water treatment plant at University Park has been dropped from further consideration due to excessive cost.

III. PROJECTIONS

A. Population Projections

Population projections have been made for the various communities in the study area. The following figures are graphical representation of the historical data and future population projections. Historical population data were gathered from U.S. Census Data. Population projections were based on projections from the Chicago Metropolitan Agency for Planning (CMAP). CMAP projections for the various communities extend to the year 2040.

As shown in the figures, CMAP projects dramatic growth for all of the communities except the Village of Peotone. For the Village of Peotone, CMAP's projections is less than what the historical straight line projection would be for the community. However, for the growth of Peotone Township population, CMAP's projection is greater than what the historical straight line projection would be. This may be due to the influence of the SSA development which has more of an impact closer to the airport.

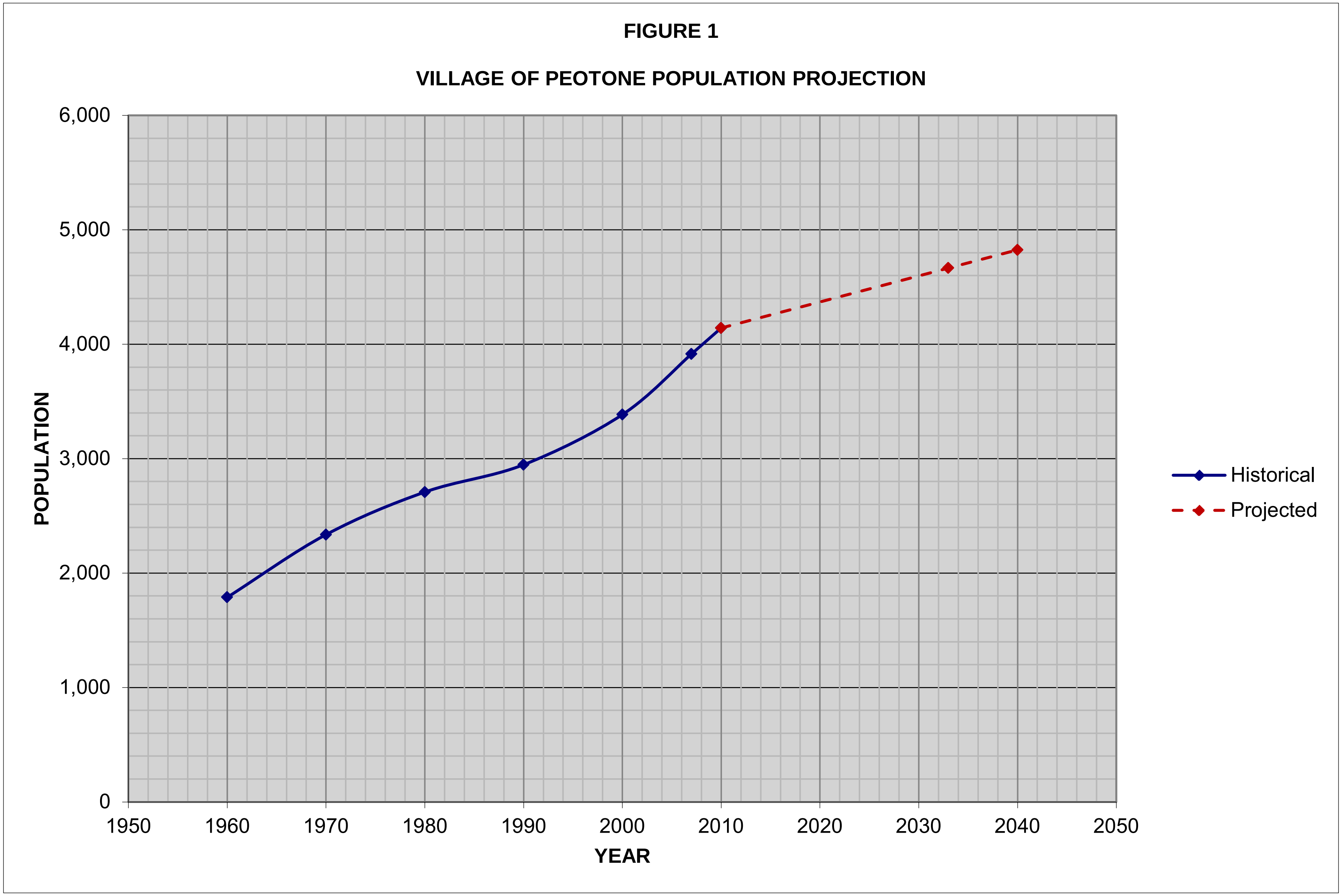


FIGURE 1
VILLAGE OF PEOTONE POPULATION PROJECTION
POPULATION
6,000
5,000
4,000
3,000
2,000
1,000
0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
YEAR
Historical
Projected

FIGURE 2

VILLAGE OF BEECHER POPULATION PROJECTION

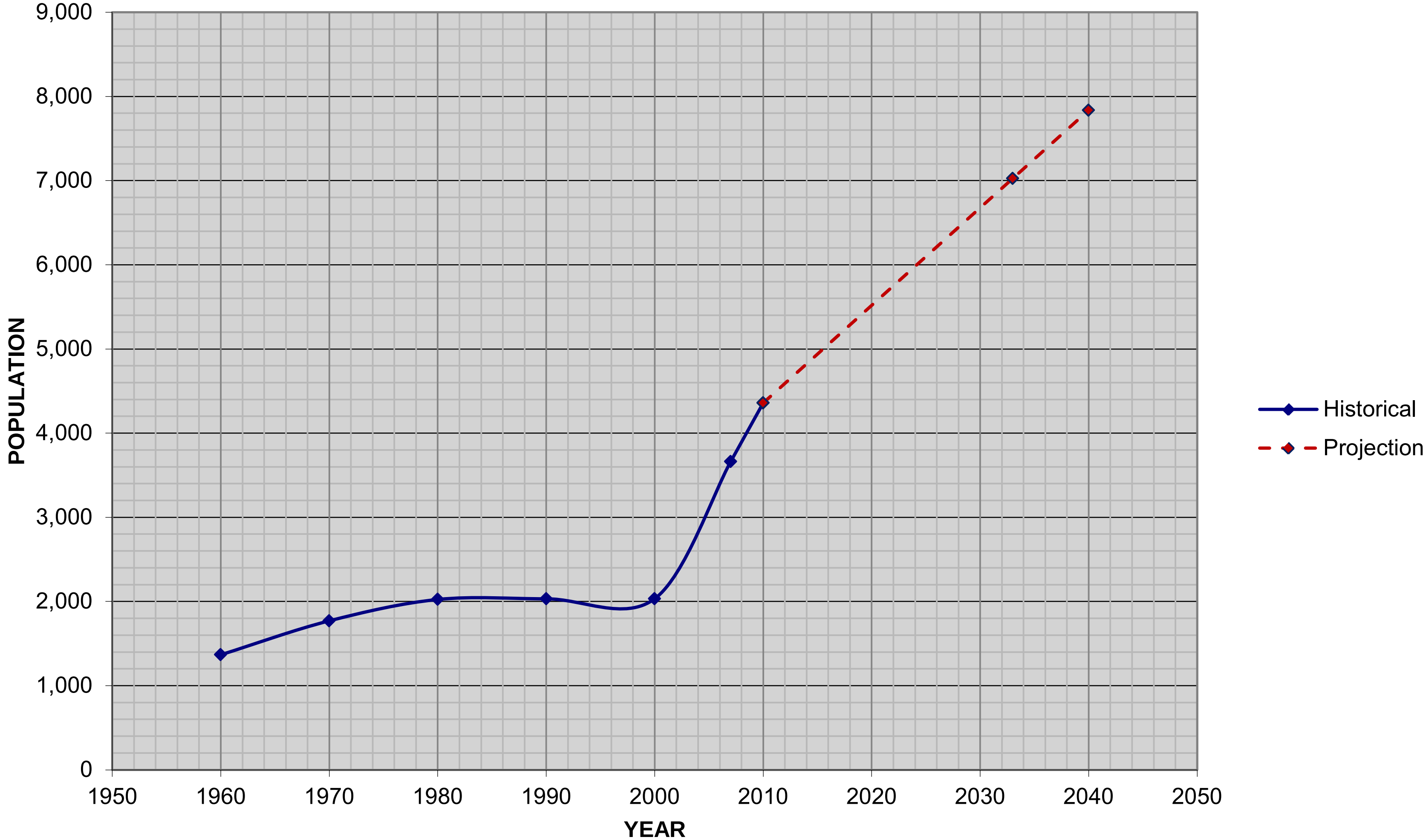


FIGURE 3

VILLAGE OF MONEE POPULATION PROJECTION

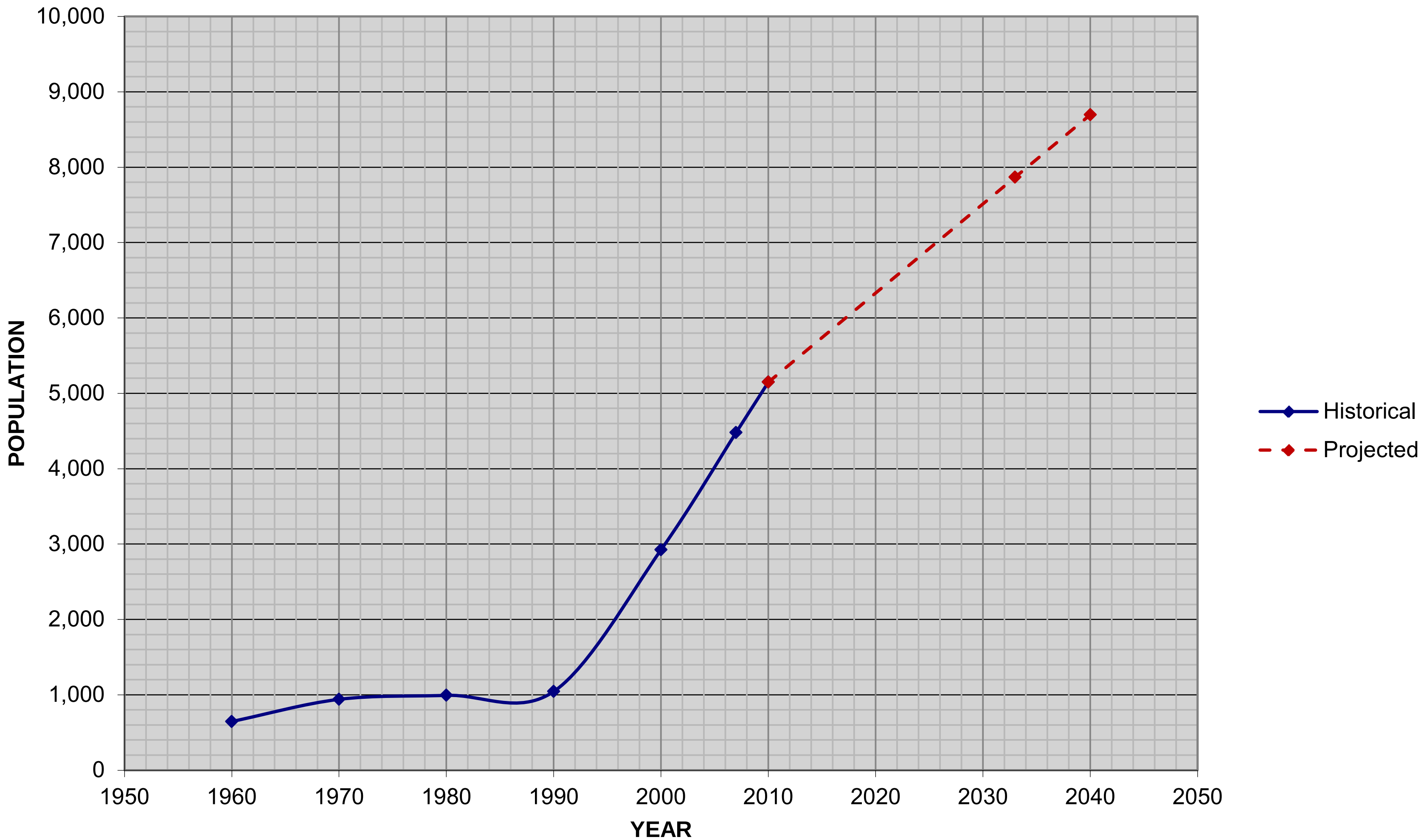
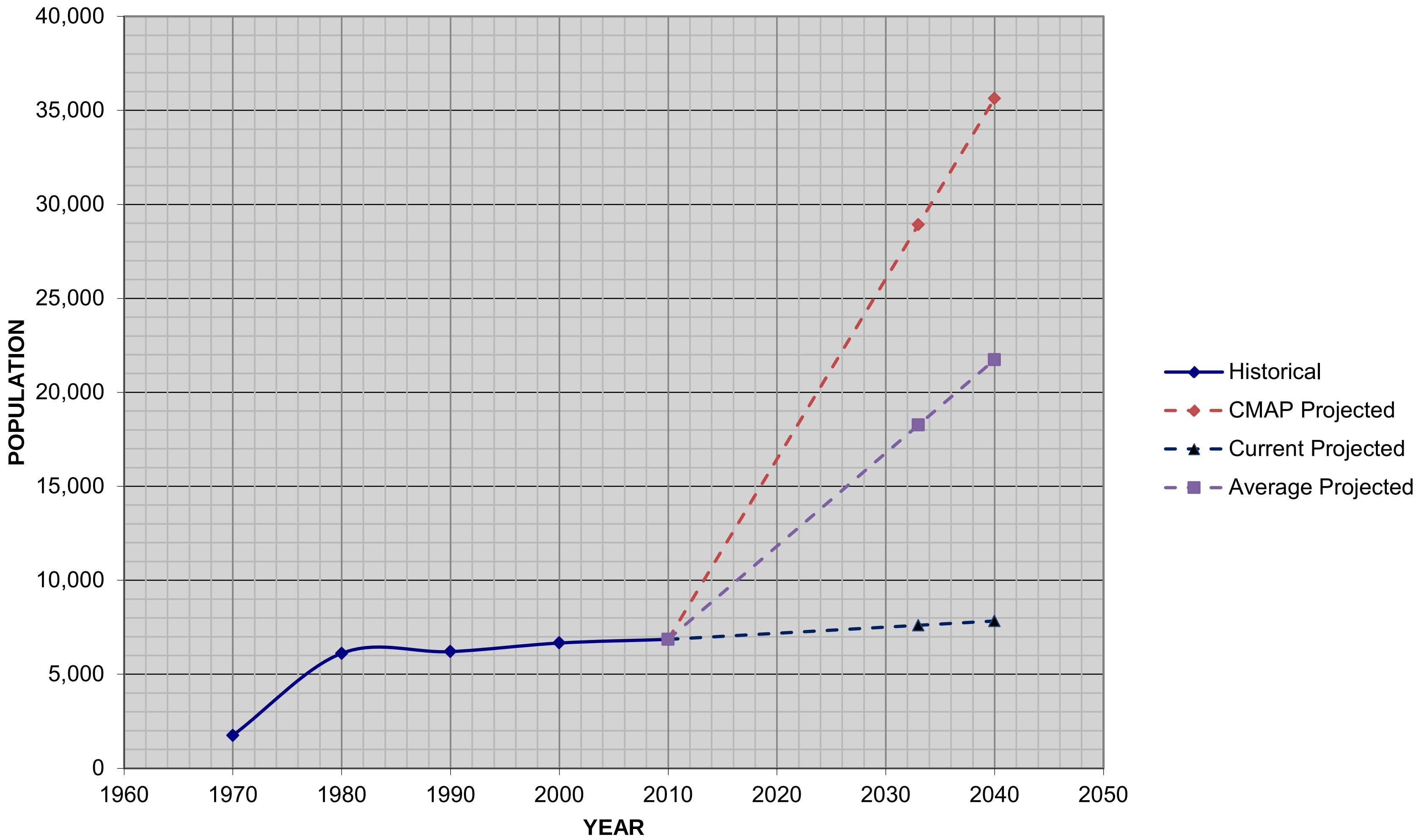


FIGURE 4

VILLAGE OF UNIVERSITY PARK POPULATION PROJECTION



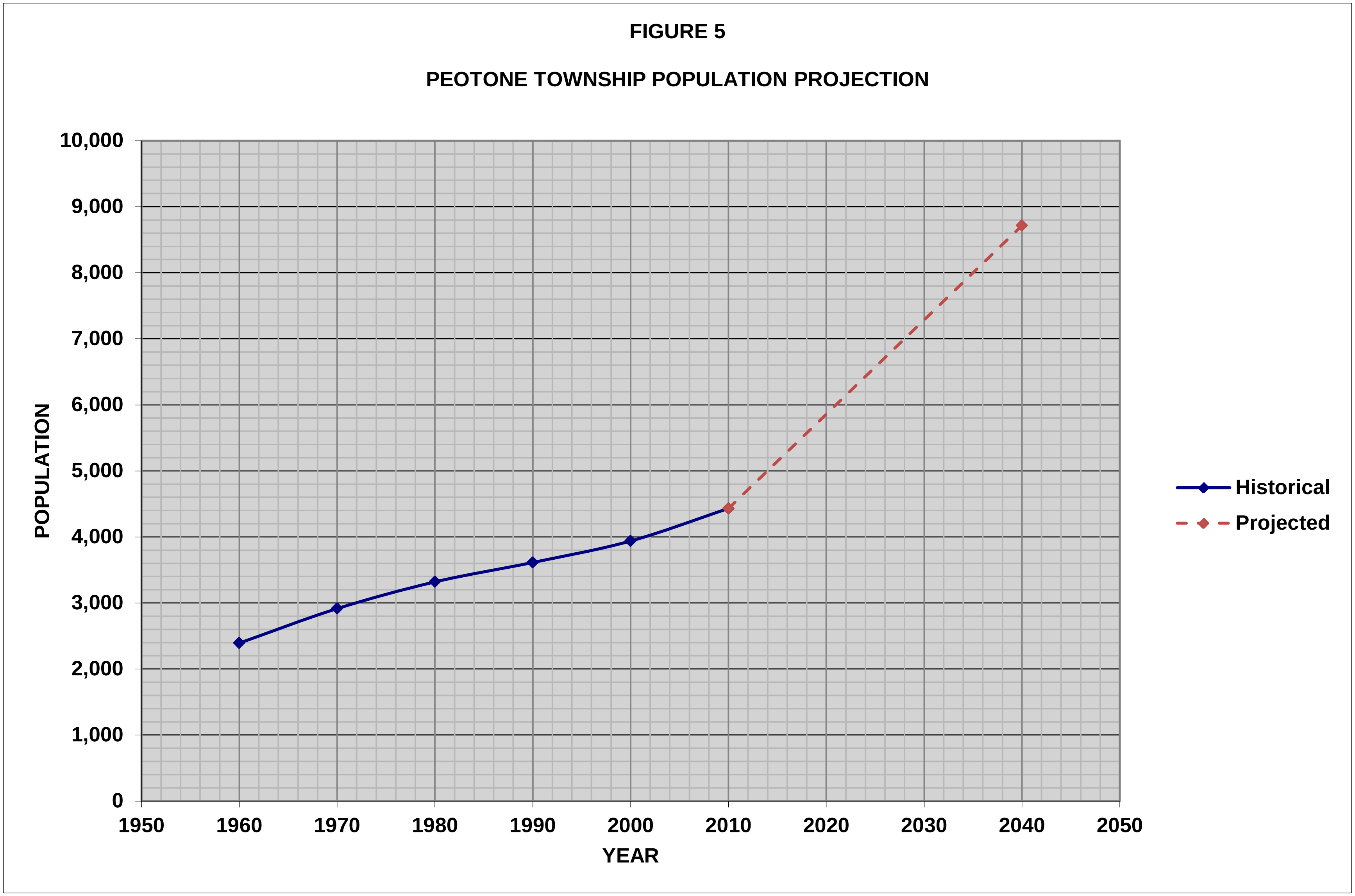


FIGURE 5
PEOTONE TOWNSHIP POPULATION PROJECTION
POPULATION
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
YEAR
Historical
Projected

FIGURE 6

WASHINGTON TOWNSHIP POPULATION PROJECTION

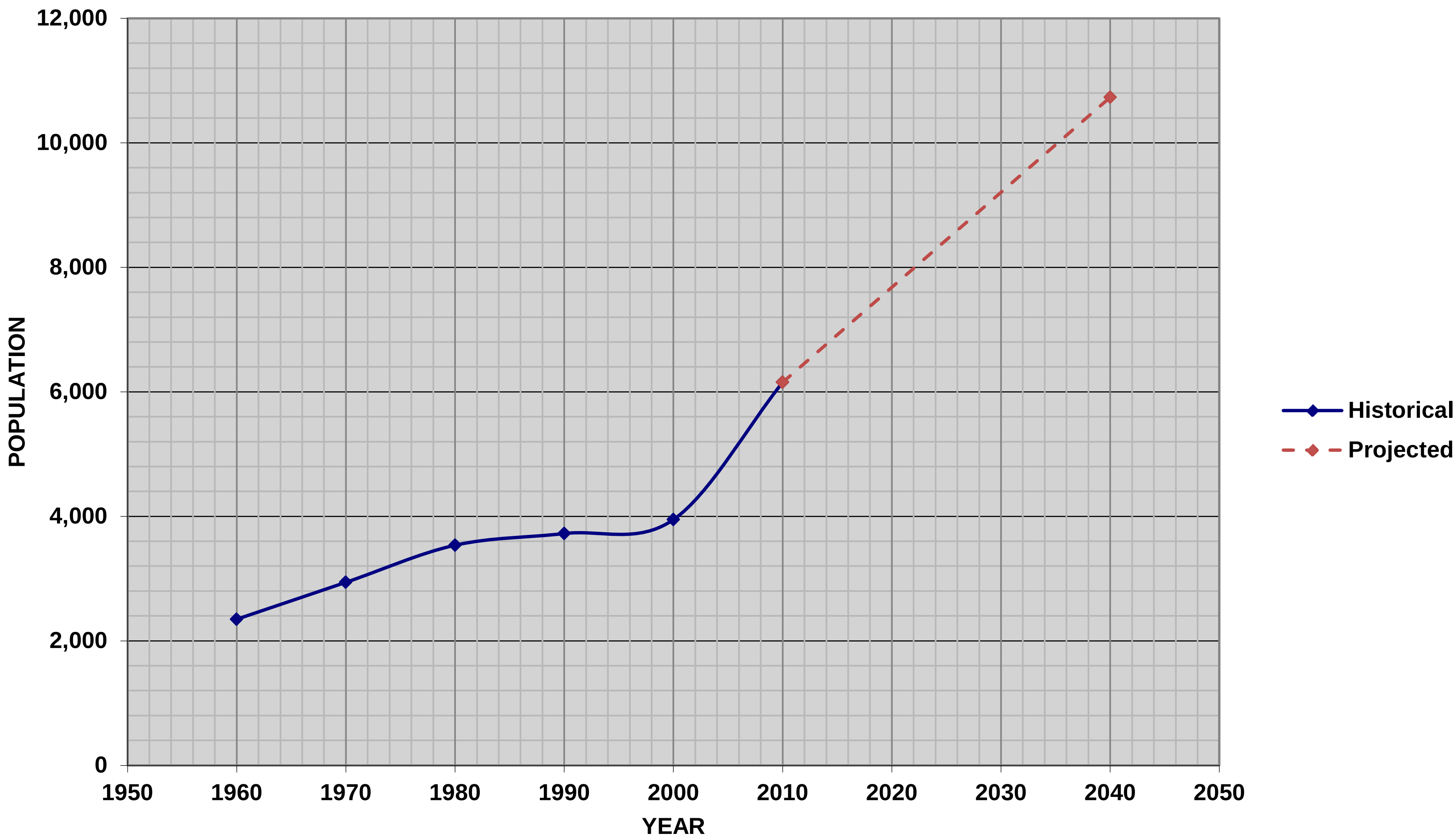


FIGURE 7

MONEE TOWNSHIP POPULATION PROJECTION

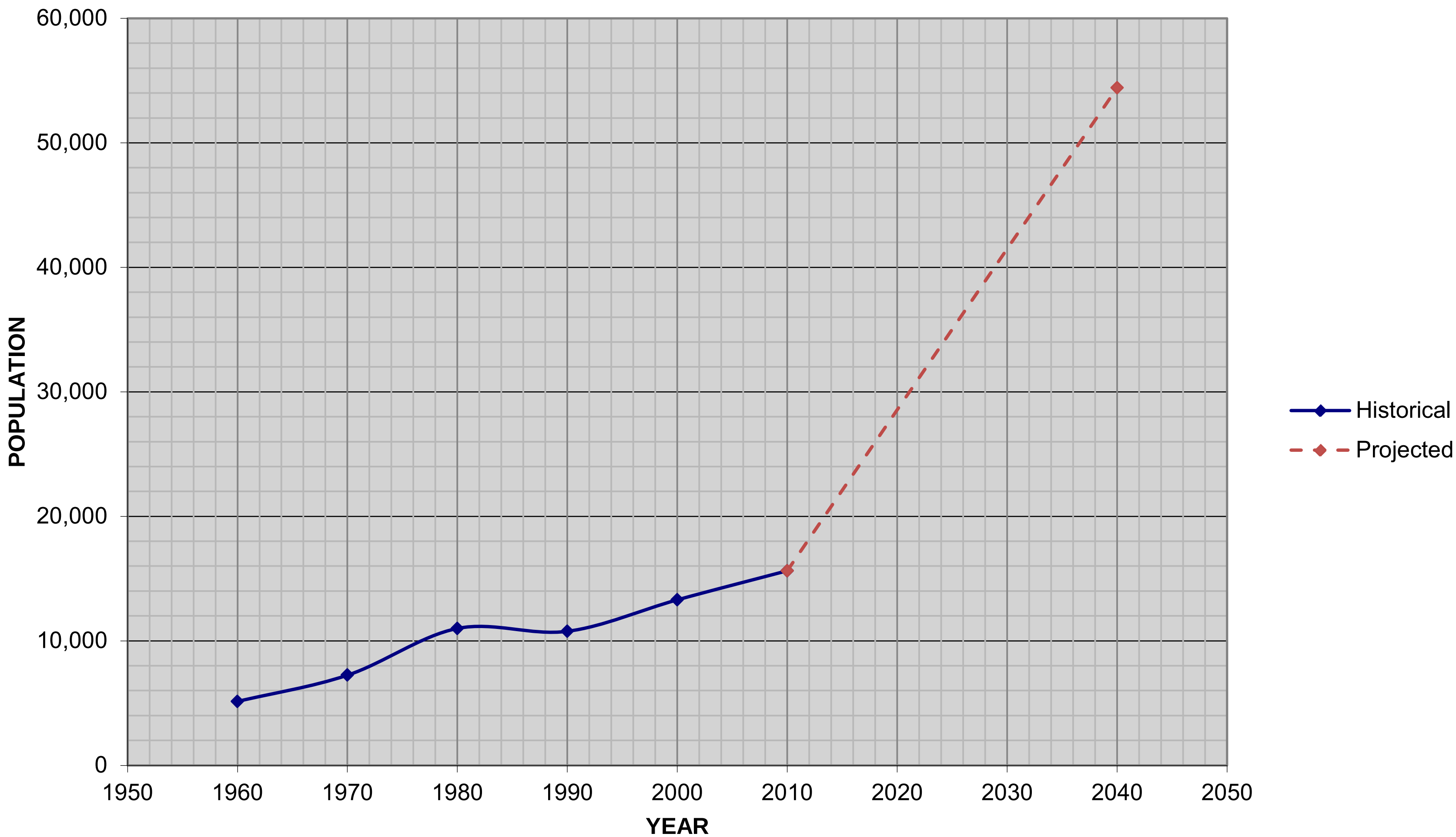
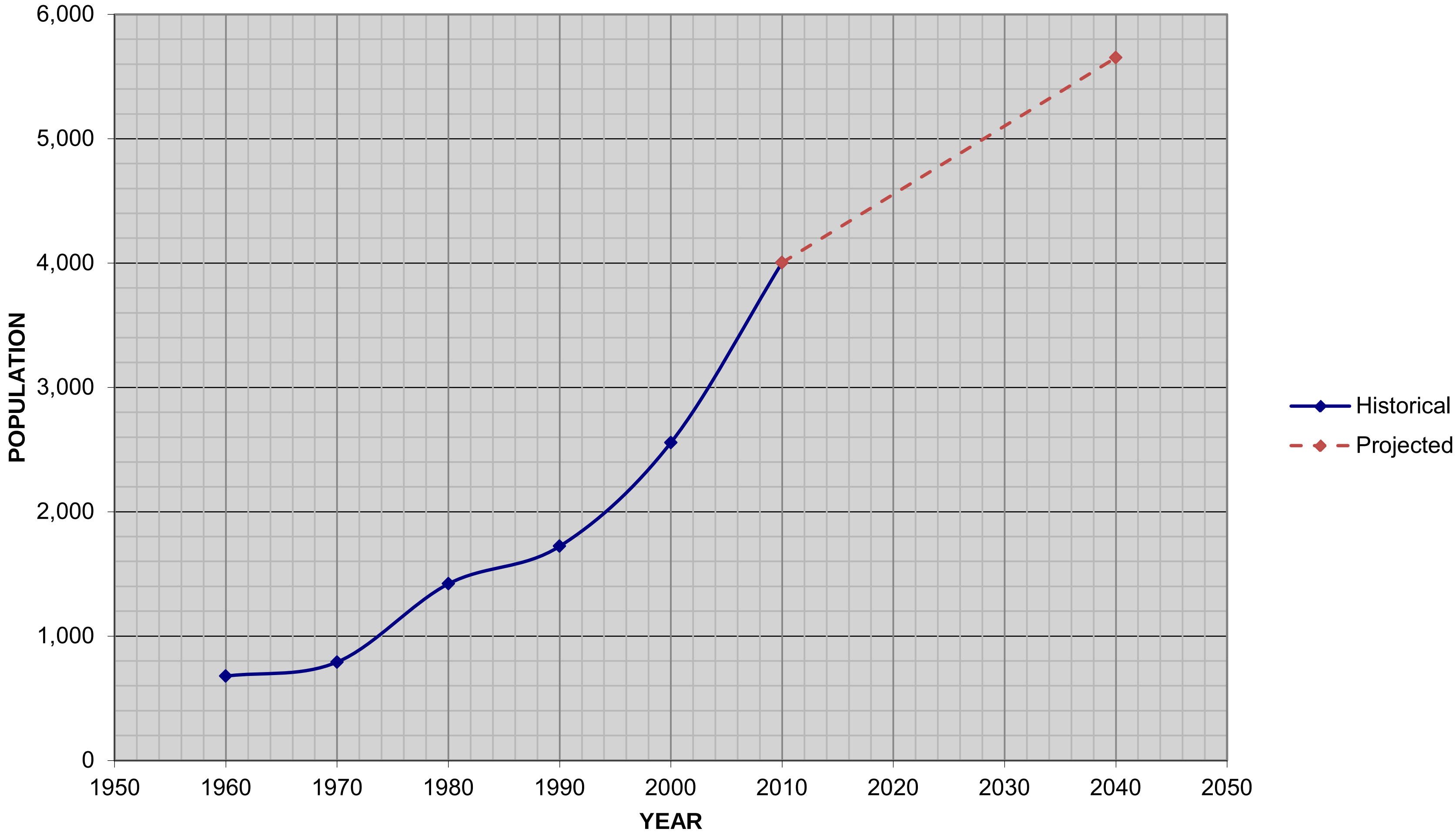


FIGURE 8

GREEN GARDEN TOWNSHIP POPULATION PROJECTION



For this report, the population projections for the year 2033 were selected for estimating future water demands for the area. The year 2033 would be 20 years following the ICC approval of the water infrastructure improvement prospect for the area. A 20 year period is a reasonable time period to use in economic analysis to compare alternatives. Also, sizing of facilities to accommodate 20 years of growth is a prudent approach.

Three different population projections were made for University Park, as shown in Figure 4. The high projection was based on CMAP's 2040 projection. Since the historical trend of growth in University Park is much lower, a projection was also made based on a straight line projection of the historical trend. The third projection is an average of these two trends.

B. Water Demand Projections

1. University Park

Historical water supply data was provided by Aqua Illinois for their University Park system. The following Table 2 summarizes the combined well pumpage data for the system including annual average pumping and maximum day pumpage data. Note that the average per capita consumption in University Park is 195 gallons per capita per day (gpcd). This is about twice the typical per capita consumption of 100 gpcd, including unaccounted water, experienced by other communities in the area. This higher per capita consumption in University Park can be attributed to the industrial park, which includes a natural gas "peaker" power plant, with a high cooling water demand, and the subdivisions in Green Garden Township which are supplied with water from University Park but would not be counted in the census data for University Park.

Table 2 also shows a relatively high maximum day to average day ratio (Q Max Day: Q Avg. Day) of 2.7. This occurred in the years 2007 and 2008. Typically, the ratio of Q Max Day: Q Avg. Day is 2.0 for residential type communities.

Table 3 presents the design data to be used for pipeline or water treatment plant design. It assumes the present high per capita demand continues into the future. The design pumping rate in 2033 is calculated by multiplying the average day per capita demand of 195 gpcd times the design year population times 2.7 to determine the maximum day demand. This number is then multiplied by 1.5 to account for the pumpage occuring within 16 hours. The resulting number is the design pumping rate. In table 3, the pumping rate has been calculated for three population projections. The first is based on CMAP's projection. The second is based on the current growth trend and the third is based on the average of the two. The last number 10,000 gpm, is the pump rate for average growth, which is used for the high demand scenario in this report.

Table 4 makes a more moderate projection of water demand for University Park using 100 gpcd for the future additional population, and 195 gpcd for the current population. The methodology for calculating the design year pumping rate is otherwise the same as described above. The resulting number of 7,000 gpm for average growth is used for the medium and low demand scenarios in this report.

TABLE 2
UNIVERSITY PARK
WATER PUMPAGE HISTORICAL DATA

Year	Population	Pumpage Annual, gal	Average, gpd	Per Capita, gpcd	Max Day, gpd	Max Day:Avg Day
2000	6,662	413,352,004	1,132,471	170		
2001	6,681	425,038,537	1,164,489	174		
2002	6,701	478,102,014	1,309,869	195		
2003	6,720	445,672,200	1,221,020	182		
2004	6,740	510,779,000	1,399,395	208	2,704,000	1.9
2005	6,759	518,289,000	1,419,970	210	3,044,000	2.1
2006	6,778	520,836,470	1,426,949	211	3,178,000	2.2
2007	6,798	563,686,212	1,544,346	227	4,165,000	2.7
2008	6,817	490,973,457	1,345,133	197	3,684,000	2.7
2009	6,837	478,812,985	1,311,816	192	2,692,000	2.1
2010	6,856	481,148,401	1,318,215	192	3,294,000	2.5
2011	6,875	461,296,607	1,263,826	184	3,002,000	2.4

TABLE 3
UNIVERSITY PARK
WATER PUMPAGE DESIGN DATA – HIGH DEMAND

Parameter	Projected Pumping Rate, gpm CMAP	Current Growth	Average
Average Day Demand, gpcd	195	195	195
Q Max. Day: Q Avg. Day	2.7	2.7	2.7
Max. Day Pumping Hrs.	16	16	16
Current Pumping Rate, gpm	3,764	3,764	3,764
2033 Pumping Rate, gpm	15,875	4,175	10,025

TABLE 4
UNIVERSITY PARK
WATER PUMPAGE DESIGN DATA – MEDIUM DEMAND

Parameter	**Projected Pumping Rate, gpm**		
	CMAP	**Current Growth**	**Average**
Current Conditions:			
Average Day Demand, gpcd	195	195	195
Q Max. Day: Q Avg. Day	2.7	2.7	2.7
Max. Day Pumping Hrs.	16	16	16
Current Pumping Rate, gpm	3,764	3,764	3,764
Projections:			
Average Day Demand, gpcd	100	100	100
Q Max. Day: Q Avg. Day	2.7	2.7	2.7
Max. Day Pumping Hrs.	16	16	16
2033 Pumping Rate, gpm	9,969	3,974	6,972

2. Village of Peotone

The water demands of nearby communities to University Park have been estimated to determine the total demand on the aquifer. The water pumpage data for the Village of Peotone is presented in Table 5. The pumpage was determined from well pumpage data obtained from the Illinois State Water Survey (ISWS). The wells in Peotone are open to the Silurian Dolomite Aquifer.

Table 6 presented the design data used in this report. The methodology for calculating the design year pumping rate is the same as described above for University Park. The resulting number of 900 gpm is used for the high and medium demand scenarios in this report.

TABLE 5
VILLAGE OF PEOTONE
WATER PUMPAGE HISTORICAL DATA

		Pumpage		
Year	**Population**	**Annual, gal**	**Average, gpd**	**Per Capita, gpcd**
1960	1788			
1970	2336			
1980	2708	85,011,980	232,910	86
1990	2947	127,952,000	350,553	119
2000	3385	122,358,000	335,227	99
2007	3915	136,465,000	373,877	96
2010	4142	125,286,000	343,249	83
2033	4666			

TABLE 6
VILLAGE OF PEOTONE
WATER PUMPAGE DESIGN DATA

Average Day Demand	92	gpcd
Q Max. Day: Q Avg. Day	2.0	
Max. Day Pumping Hrs.	16	hours
Current Pumping Rate	798	gpm
2033 Pumping Rate	899	gpm

3. Village of Beecher

The water demands of nearby communities to University Park have been estimated to determine the total demand on the aquifer. The water pumpage data for the Village of Beecher is presented in Table 7. The pumpage was determined from well pumpage data obtained from the Illinois State Water Survey (ISWS). The wells in Beecher are open to the Silurian Dolomite Aquifer.

Table 8 presents the design data used in this report. The methodology for calculating the design year pumping rate of 1900 gpm is the same as described above for University Park.

TABLE 7
VILLAGE OF BEECHER
WATER PUMPAGE HISTORICAL DATA

		Pumpage		
Year	**Population**	**Annual, gal.**	**Average, gpd**	**Per Capita, gpcd**
1960	1367			
1970	1770			
1980	2024	91,275,700	250,070	124
1990	2032	96,203,500	263,571	130
2000	2033	86,036,000	235,715	116
2007	3661	140,466,000	384,838	105
2010	4359	142,246,000	389,715	89
2033	7025			

TABLE 8
VILLAGE OF BEECHER
WATER PUMPAGE DESIGN DATA

Average Day Demand	113	gpcd
Q Max. Day: Q Avg. Day	2.3	
Max. Day Pumping Hrs.	16	hours
Current Pumping Rate	1177	gpm
2033 Pumping Rate	1898	gpm

4. Village of Monee

The water demands of nearby communities to University Park have been estimated to determine the total demand on the aquifer. The water pumpage data for the Village of Monee is presented in Table 9. The pumpage was determined from well pumpage data obtained from the Illinois State Water Survey (ISWS). The wells in Monee are open to the Silurian Dolomite Aquifer.

Table 10 presented the design data used in this report. The methodology for calculating the design year pumping rate is the same as described above for University Park. The resulting number of 1,800 gpm is used for the high and medium demand scenarios in this report.

TABLE 9
VILLAGE OF MONEE
WATER PUMPAGE HISTORICAL DATA

		Pumpage		
Year	**Population**	**Annual, gal**	**Average, gpd**	**Per Capita, gpcd**
1960	646			
1970	940			
1980	993	34,800,000	95,342	96
1990	1044	32,571,000	89,236	85
2000	2924	119,915,000	328,534	112
2007	4481	156,961,000	430,030	96
2010	5148	152,855,000	418,781	81
2033	7868			

TABLE 10
VILLAGE OF MONEE
WATER PUMPAGE DESIGN DATA

Average Day Demand	94	gpcd
Q Max. Day: Q Avg. Day	2.3	
Max. Day Pumping Hrs.	16	hours
Current Pumping Rate	1162	gpm
2033 Pumping Rate	1776	gpm

C. <u>Pipeline Design Pumping Rate</u>

In order to evaluate a pipeline from Aqua Illinois' system in Manteno to provide water to the study area, three water demand scenarios have been formulated: high, medium and low. From these scenarios, various pipeline sizes have been determined as discussed below. Two areas of growth are shown in the following tables: growth within the existing system service area and growth outside the existing service area. The flows shown are the peak pumping rates as calculated above, both for current conditions and the year 2033. Table 11 shows the high flow scenario, utilizing the high flow projections for University Park and future growth areas. Table 12 is the medium flow scenario. In this table, the future peak demand for the existing University Park service area is reduced from 10,000 to 7,000 gpm to reflect lower per capita demand as discussed above. The demands from future growth areas remain the same as for the high flow scenario. Table 13 presents the low flow scenario. Here moderate growth in the University Park service area is assumed and the demand from future growth area is minor.

TABLE 11
PIPELINE HIGH FLOW SCENARIO

Service Area	Current	Projected 2033
University Park/Aqua System	3,800	10,000
Future Growth Areas	0	3,000
Total Pumping Rates, gpm	**3,800**	**13,000**

TABLE 12
PIPELINE MEDIUM FLOW SCENARIO

Service Area	Current	Projected 2033
University Park/Aqua System	3,800	7,000
Future Growth Areas	0	3,000
Total Pumping Rates, gpm	**3,800**	**10,000**

TABLE 13
PIPELINE LOW FLOW SCENARIO

Service Area	Current	Projected 2033
University Park/Aqua System	3,800	7,000
Future Growth Areas	0	200
Total Pumping Rates, gpm	**3,800**	**7,200**

Table 14, below, is a summary of the pipeline design scenarios. The current population and projected population to be served is also to be shown for comparison.

TABLE 14
PIPELINE DESIGN FLOW SUMMARY

			2033 PROJECTIONS					
	CURRENT CONDITIONS		LOW RATE		MOD RATE		HIGH RATE	
Service Area	**Population**	**Pump Rate, gpm**	**Population**	**Pump Rate, gpm**	**Population**	**Pump Rate, gpm**	**Population**	**Pump Rate, gpm**
University Park/Aqua System	6,856	3,800	18,262	7,000	18,262	7,000	18,262	10,000
Future Growth Area	N.A.	0	N.A.	200	N.A.	3,000	N.A.	3,000
Total Pumping Rates, gpm		**3,800**		**7,200**		**10,000**		**13,000**

IV. PIPELINE DESIGN

A. Pipeline Materials

The following materials have been considered for the construction of the water main from Aqua Illinois' water system in Manteno to University Park: ductile iron, polyvinyl chloride (PVC) and high density polyethylene (HDPE).

Fiberglass reinforced pressure pipe was considered briefly but rejected due to the limit in available pressure class, 250 psi, this pressure class was judged to be inadequate for occasional pressure surges which could be experienced. The maximum transient surge capacity for this pipe is 350 psi.

The pipe sizes and classifications selected for this pipeline design are summarized in the following Table 21. A hydraulic model has been constructed for a pipeline to handle the low, medium and high flows for each of the pipe materials. The resultant pipe sizes are listed for the pipeline segments to carry the requisite flow between water draw-off points along the pipeline. The methodology for sizing the pipelines is discussed below.

TABLE 15
AQUA WATER MAIN DESIGN SUMMARY

DUCTILE IRON PIPELINE
Pipeline C Factor = 130
Tank O/F Elevation at UP= 817.5
Elevation at Manteno = 677

Segment of Pipeline	HIGH FLOW			MODERATE FLOW			LOW FLOW		
	Flow Rate, gpm	Pipeline Size	I.D., In.	Flow Rate, gpm	Pipeline Size	I.D., In.	Flow Rate, gpm	Pipeline Size	I.D., In.
Manteno to Peotone	13,000	36 in., PC 200	37.21	10,000	30 in., PC 250	30.91	7,200	24 in., PC 350	24.75
Peotone to Monee	12,000	30 in., PC 250	30.91	8,900	30 in., PC 200	30.99	7,200	24 in., PC 350	24.75
Monee to University Park	10,000	30 in., PC 150	31.07	7,000	24 in., PC 200	24.95	7,000	24 in., PC 200	24.95

HDPE PIPELINE - PE 3408, DIPS
Pipeline C Factor = 140
Tank O/F Elevation at UP= 817.5
Elevation at Manteno = 677

Segment of Pipeline	HIGH FLOW			MODERATE FLOW			LOW FLOW		
	Flow Rate, gpm	Pipeline Size	I.D., In.	Flow Rate, gpm	Pipeline Size	I.D., In.	Flow Rate, gpm	Pipeline Size	I.D., In.
Manteno to Peotone	13,000	36 in., DR 11	31.33	10,000	36 in., DR 11	31.33	7,200	30 in., DR 11	25.83
Peotone to Monee	12,000	36 in., DR 11	31.33	8,900	30 in., DR 11	25.83	7,200	30 in., DR 11	25.83
Monee to University Park	10,000	36 in., DR 11	31.33	7,000	30 in., DR 11	25.83	7,000	30 in., DR 11	25.83

TABLE 15
AQUA WATER MAIN DESIGN SUMMARY

PVC PIPELINE - AWWA C905, DIPS
Pipeline C Factor = 140
Tank O/F Elevation at UP= 817.5
Elevation at Manteno = 677

Segment of Pipeline	HIGH FLOW			MODERATE FLOW			LOW FLOW		
	Flow Rate, gpm	Pipeline Size	I.D., In.	Flow Rate, gpm	Pipeline Size	I.D., In.	Flow Rate, gpm	Pipeline Size	I.D., In.
Manteno to Peotone	13,000	36 in., DR 25	35.05	10,000	30 in., DR 25	29.29	7,200	24 in., DR 18	22.76
Peotone to Monee	12,000	30 in., DR 25	29.29	8,900	30 in., DR 25	29.29	7,200	24 in., DR 18	22.76
Monee to University Park	10,000	30 in., DR 25	29.29	7,000	24 in., DR 25	23.61	7,000	24 in., DR 25	23.61

1. Ductile Iron Pipe

Ductile Iron is the standard pipe material used by Aqua Illinois for new installations. It was introduced to the market place in 1955. It commonly has an applied cement lining and with polyethylene encasement, it is generally corrosion resistant. Ductile Iron is available in pressure classes (PC's). The pressure class is considered the allowable working pressure for the pipe. A pressure surge allowance is also included in the design of the pipe per AWWA C150 in the amount of 100 psi over the working pressure allowance. The hydraulic models utilize PC 150 through PC 350. The higher pressure classes are needed starting out at the Manteno pump station. As the main traverses north, the water pressure in the main decreases due to a rise in ground elevation and the decline of the hydraulic grade line due to friction losses when the water is being pumped. The minimum pressure in the main would be 20 psi at the tank in University Park. IEPA requires that the pressure in the water main be a minimum of 20 psi at all points along the main. The literature reports a d factor for ductile iron with cement lining of 140. The C factor is a measure of friction loss in the pipe with a higher C factor applied to smoother pipe. A C factor of 130 was used in the hydraulic model for this report.

2. PVC Pipe

PVC is a thermoplastic class of pipe. It was introduced in North America in 1951. By the 1970's, PVC was widely used for water main construction. PVC is noted for its corrosion resistance and light weight, and a high C factor of 150. For this report, a C factor of 140 for PVC pipe has been assumed. Concern has been expressed for its strength as compared with ductile iron. However, a recent article in the AWWA Journal has shown that PVC pipe currently has the lowest overall number of failures per 100 mi (2.6) than any other pipe material including ductile iron (4.9)[3]. This study reported on 188 systems, which included 117,600 miles of water main. Of this quantity of main, 28% was cast iron, 28% was ductile iron and 23% was PVC.

AWWA has issued a cautionary note on PVC relative to permeation. AWWA Standard C905 for PVC pipe states that research has documented that PVC pipe materials are subject to permeation by lower molecular weight organic solvents or petroleum products. If the PVC water main is located in soils contaminated with this type of pollutant, permeation would be of concern.

PVC pipe would meet AWWA Standard C905, for large diameter PVC pipe (14 in. through 48 in.) with ductile iron pipe outside diameter. The pipe is classified by Dimension Ratio (DR), which is defined as the ratio between the outside diameter to the wall thickness of the pipe. For this study, DR's of the selected main are DR 25 and DR 18. The corresponding pressure classes (PC) for these DR's are 165 psi and 235 psi, respectively. The occasional surge pressure capacity of the pipe per AWWA C905 is 1.6 times the PC. For DR 25 and DR 18, the pressure surge capacity of the pipe, would be 264 psi and 376 psi, respectively.

3. HDPE Pipe

Like PVC, HDPE is also classified as a thermosplastic material. The first PE water piping systems were installed in the US in the early 1960's. HDPE pipe properties like PVC pipe, give it the advantage of corrosion resistance and light weight; but also like PVC pipe it is subject to

[3] Folkman et. al., "Survey of Water Main Failures in the Unites States and Canada," JAWWA, October 2012.

permeation by low molecular weight petroleum products. The C factor for HDPE pipe as reported in the literature is 150. For this report, a C factor of 140 for HDPE pipe has been assumed. The quantity of HDPE water main pipe installed in the US is much less than the quantity of PVC water main or ductile iron water main; however, in the United Kingdom it is the predominant water main pipe for new installations. No failure rate data is available in the above reference 3 for HDPE water main pipe due to its limited use in North America. Early concerns with the effect of chlorinated water on HDPE pipe have been addressed with current HDPE material formulations. Due to its flexible nature, HDPE is preferred material for the horizontal directional drilling method of installation.

HDPE pipe would meet AWWA Standard C906 for 4 in. through 63 in. pipe, with ductile iron pipe outside diameter. The HDPE pipe is classified by Dimension Ratio (DR) defined the same as for PVC pipe. This study only considers DR 11 pipe since this is the thinnest wall HDPE pipe that IEPA allows. The corresponding pressure class (PC) for HDPE DR 11 is 160 psi. The occasional surge pressure capacity of the pipe is 2 times the PC or 320 psi.

4. Pressure Surge Analysis

The pipeline design considers the occasional pressure surges that could occur in the pipeline due to sudden changes in velocity of the water such as power failure during pump operation or sudden valve closure. For this analysis, the maximum surge pressure was calculated for each pipeline assuming the maximum pumping rate, or velocity in the pipeline, and the velocity suddenly changing to zero. The type of pipe material affects the amount of pressure surge experienced under a sudden velocity change. Under the same operating conditions, ductile iron pipe would experience a higher surge pressure than PVC or HDPE pipe. This is because of the more rigid nature of ductile iron compared to PVC or HDPE. For example, at a sudden velocity change of 5 fps, the following surge pressures over the normal operating pressure would be experienced by the various pipeline materials:

Ductile Iron, PC350	PVC, DR18	HDPE, DR11
239 psi	87 psi	72 psi

The pressure surge analysis determines the recommended pressure class (PC) or dimension ratio (DR) for the pipeline which would be designed in segments with the required pressure class diminishing from south to north along the pipeline due to the reduced normal operating pressure as discussed above.

5. Life Expectancy

For the economic analysis of the pipeline alternatives, an estimate of the useful life expectancy of the various pipeline materials has been made. From the history of the three types of pipe material, ductile iron, PVC and HDPE, which all have a 50 year history in the U.S. and comparable failure rates, it can be claimed that the life expectancy of any of these pipe materials is a minimum of 50 years. The performance of the various pipe materials over this period have generally been successful. Earlier generations of PE in potable water exhibited poor performance due to the affect of chlorinated water on the material. However, material improvements resulted in high utility satisfaction for HDPE mains and services installed in the last 20 years[4].

[4]Jana Laboratories, Inc., "Technical Report: Poyethylene Pipe Performance in Potable Water Distribution System," August 2011.

Reported cyclic stressing on the pipe due to pressure surges can affect the life expectancy of the pipe. With any construction material, repeated stressing can cause material fatigue and failure. PVC and HDPE have lower cyclic endurance limits than ductile iron. However, this factor is taken into consideration in the design basis for the material. The number of pressure cycles would not be a factor in determining the life of the main under study in this report. For example, Utah State University subjected a PVC DR18 pipe to a base pressure of 185 psi and surged the pressure to a peak of 235 psi over 3 million times without a failure[5]. The researchers predicted the number of cycles to failure to be 10 million.

For the economic evaluation of the pipelines 50 year was selected although a life expectancy approaching 100 years is likely. Aqua Illinois uses a depreciation rate of 1.89% per year. This number reflects that the length of time the cost of the water main remains on the balance sheet would be 53 years. This is the economic life expectancy for the water main. In fact, the life of the main should exceed this number.

B. Pipe Sizing

As a rule of thumb, pipeline designers have selected 5 fps as the maximum velocity of water in transmission mains equating to the most economical design. To test this rule for the main under study for Aqua, a present worth analysis was performed as shown in the Table 22 below for the low flow scenario of 7,000 gpm. A present worth analysis considers the first cost, or capital cost of the project and brings the annual cost of operations to a present cost by applying a factor to the annual cost.

For this study, the power cost is the only operating cost that varies significantly between pipe sizes. The salvage value of the project at the end of the study period is also brought to a present cost, which is a negative, or offsetting cost. The total of these three numbers, capital cost, present worth of power cost, and present worth of salvage value, gives the total present worth. The lowest total present worth is the most economical alternative.

The assumptions for the present worth analysis are shown in the table. The allowed rate of return, which was used for the interest rate in the study, and the depreciation rate were given by Aqua Illinois' Accounting Department.

[5]Uni-Bell PVC Pipe Association, "Thermoplastic Pressure Pipe Design and Selection," UNI-TR-7-01

TABLE 16
PRESENT WORTH ANALYSIS FOR PIPELINE SIZING

ASSUMPTIONS

Allowed Rate of Return	**9.49%**
Depreciation Rate	**1.89%**
Term of Study, years	**20**
Single Payment Present Worth Factor	**0.1631**
Uniform Series Present Worth Factor	**8.8185**
Power Cost, $/kw-hr	**$0.10**
Length of Main, ft.	**104,400**
Annual Pumping Volume, MG	**1,070**

DIP Main Installation Costs

20" Main	**$ 115**	**per ft.**
24" Main	**$ 145**	**per ft.**
30" Main	**$ 170**	**per ft.**

PIPELINE SCENARIOS POWER COSTS

Parameter	Pump Rate, gpm	Volume, %	Annual Volume, MG	20" PIPELINE - 7 fps Peak			24" PIPELINE - 5 fps Peak			30" PIPELINE - 3 fps Peak		
				TDH	KW-HRS	Power Costs, $	TDH	KW-HRS	Power Costs, $	TDH	KW-HRS	Power Costs, $
Average Day Pumping	3,000	50%	535	277	465,457	$46,546	177	297,422	$29,742	137	230,208	$23,021
Maximum Month Pumping	4,500	40%	428	456	612,992	$61,299	245	329,349	$32,935	160	215,085	$21,508
Maximum Day Pumping	7,000	10%	107	899	302,127	$30,213	422	141,822	$14,182	228	76,624	$7,662
Total Pumping Cost						**$138,058**			**$76,859**			**$52,192**

Note: TDH is Total Dynamic Head to pump the water to University Park

TABLE 16
PRESENT WORTH ANALYSIS FOR PIPELINE SIZING

PRESENT WORTH ANALYSIS

	20" Main	24" Main	30" Main
Capital Cost of Installation	$ 12,006,000	$ 15,138,000	$ 17,748,000
Present Worth of Salvage Value	$ (1,218,147)	$ (1,535,924)	$ (1,800,739)
Present Worth of Power Costs	$ 1,217,466	$ 677,786	$ 460,254
Total Present Worth	**$ 12,005,319**	**$ 14,279,862**	**$ 16,407,516**

The power cost used was $0.10/kw-hr. The water main costs were based on a ductile iron water main from the cost estimates below. The peak flow rate selected was 7,000 gpm, representing the low flow scenario. The pipe sizes selected for comparison were 20in., 24 in., and 30 in., three consecutive sizes for pipe. The velocity of the water in the mains at 7,000 gpm each are as follows: 20 in. – 7 fps; 24 in. – 5 fps; 30 in. – 3 fps. The pump rates were assumed to vary throughout the year with the use of variable frequency drives (VFD's) to pump at rate to match demand, thus conserving energy. The power costs were calculated for the estimated volume of water pumped at each rate.

The total present worth based on this analysis for the three main sizes are as follows: 20 in. - $12,000,000; 24 in. - $14,300,000; 30 in. - $16,400,000. At first glance, the 20 in. main would appear more economical. However, to utilize a 20 in. main, additional pump stations to the one at Manteno would be required along the route. A single pump station at Manteno would require a pump station and pipeline at Manteno with a design operating pressure of 400 psi at the peak flow of 7,000 gpm. One or two additional pump stations would be required along the route to keep the pressures within a reasonable range. With the 24 in. main, the pressure would be 190 psi and with the 30 in. main the pressure would be 100 psi with only one pump station at Manteno. Thus the 20 in. main at 7 fps peak operating velocity is not considered an economical alternative. That leaves the 24 in. main, operating at a peak velocity of 5 fps with the lowest total present worth. Consequently, the use of 5 fps for the peak flow design velocity appears justified.

By the same methodology, it can be shown that the 30 in. main is the most economical design for the medium flow scenario of 10,000 gpm peak flow and the 36 in. size pipeline is the most economical design for the high flow scenario of 13,000 gpm peak flow. After selecting the peak design flow to the study area, the pipeline would be sized for a peak velocity of water in the main of 5 fps.

V. PIPELINE ROUTES

A. Comparison of Alternative Routes

Five major north-south routes were considered preliminarily as alternatives for the water main. These routes are illustrated in Figure 9 of the Appendix. All routes start from the 3 million gallon (MG) tank in Illinois Diversatech at Manteno at the south end and extend to the two 1.5 MG tanks at the industrial park on Central Avenue in University Park. These routes, which are numbered one through five are as follows:

Route 1 – I57 Corridor
Route 2 – Illinois Route 50 Corridor
Route 3 – Canadian National Railroad
Route 4 – Center Road, also known as County Highway 19
Route 5 – Will Center Road, also known as County Highway 10

Route 5A is a variant of Route 5. This route starts at the existing 20 in. water main to Grant Park on 8000 N. Rd. At Count Highway 9, it joins Route 5 and follows Route 5 the remaining way to University Park.

Figure 9 includes a table or decision matrix for the routes to assist in deciding on the best route. One of the primary considerations is the length of the route which affects the capital and operating costs of the water main alternative. The length of the routes to University Park range from 15.5 mi for Route 5A (Will Center Road) to 20.8 mi for Route 4 (Center Road). Another important consideration is the length of the route in existing right-of-way (ROW). Where more existing ROW can be used for construction, less land under permanent easement needs to be acquired, which would reduce capital costs. Restrictions on the use of the ROW by the controlling authority should be considered when assessing the value of the ROW for water main construction. Temporary easements may be needed adjacent to the ROW if stockpiling dirt is not allowed in the ROW. Permits for accessing the main for operation purposes, such as flushing hydrants would be required in the railroad ROW and ROW for Interstate 57 making those ROW's very restrictive. Finally, the number of crossings of roads, railroads, streams, pipelines and wetlands is a factor for evaluating the best route for the water main. These crossings are listed in the decision matrix in Figure 9.

Upon examination of all the factors, some of the routes can be considered less favored. Interstate 57 is less favored because of the ROW restrictions on operations. The railroad ROW which is owned by Canadian National Railroad, would also have restrictive access for the water main. Moreover, the railroad would assess a $2,059,000 permit fee to install the main in the ROW. For these reasons, this route is also less favored.

Finally, the route along Center Road (County Highway 19) is also considered less favored. It is the longest of the routes, and it would have the greatest number of easements and major road crossings of any of the routes. These factors make this route the least economical of all the routes. From a cost standpoint, it can be withheld from consideration unless the other routes prove not to be feasible.

The two routes to University Park recommended for further study are Route 2 (Illinois Route 50) and Route 5 (Will Center Road, or County Highway 10). Route 5A, which is a variant of

Route 5 would be an interim alternative, with hydraulic limitations which will be discussed below. Route 2, at 16.8 miles in length, is considerably shorter than Route 5, at 19.8 miles. Its major disadvantages are that it crosses through Peotone and Monee, which is a costly and politically sensitive situation. Route 5 would require more easement acquisition but it traverses a more open area for construction.

VI. WATER MAIN CONSTRUCTION COSTS

This study has estimated construction costs for water mains along the three routes selected above: Route 2, Route 5 and Route 5A. For each of these routes, three types of pipe material were evaluated: ductile iron, PVC and HDPE. For each of these routes and type of materials, the capital costs for three design flow scenarios, high, medium and low, and associated pipeline sizes were evaluated. The capital costs are summarized in Table 17, below. Costs were developed based on pipe and valve prices obtained from vendors, R.S. Means Heavy Construction Costs Data and bid tabulations from previous jobs. Aqua America's national contract for ductile iron pipe didn't cover the pipe sizes and pressure classifications under study in this report. The capital costs of the water main alternatives utilizing ductile iron pipe would probably be less with Aqua America's negotiated pipe prices. Tables 18 through 44 in the Appendix are the detailed costs for the alternatives.

TABLE 17

AQUA ILLINOIS INC.
TRANSMISSION MAIN FROM MANTENO TO UNIVERSITY PARK
OPINION OF PROBABLE COSTS FOR VARIOUS ALTERNATIVES - 11/21/12

PIPELINE ALTERNATIVES		ROUTE 2	ROUTE 5	ROUTE 5A
MATERIAL TYPES	**DESIGN FLOW**	**IL RT 50**	**CH 10**	**CH 10 TO 8000N RD**
HDPE	High Rate Flow:	$ 23,200,000	$ 26,600,000	$ 21,000,000
PVC	Q Max. Day: 18.6 mgd	$ 17,000,000	$ 19,400,000	$ 14,700,000
Ductile Iron	Q Avg. Day : 6.2 mgd	$ 17,700,000	$ 20,100,000	$ 15,400,000
HDPE	Medium Rate Flow:	$ 20,100,000	$ 23,100,000	$ 17,700,000
PVC	Q Max. Day: 14.1 mgd	$ 13,800,000	$ 15,500,000	$ 12,200,000
Ductile Iron	Q Avg. Day : 4.7 mgd	$ 15,400,000	$ 17,300,000	$ 13,500,000
HDPE	Low Rate Flow	$ 17,100,000	$ 19,500,000	$ 15,500,000
PVC	Q Max. Day: 10.4 mgd	$ 10,800,000	$ 12,000,000	$ 9,400,000
Ductile Iron	Q Avg. Day : 3.4 mgd	$ 13,500,000	$ 15,200,000	$ 11,800,000

Engineering design fees for any of the pipeline alternatives would be $656,000 per FGI's proposed to Aqua Illinois dated August 30, 2012

In addition to the above construction and engineering design costs, the following costs of easement acquisition should be added to the project:

Route 5 - Will Center Road Easement Costs

18.6	ac	Agricultural	@	$	8,182.00	/AC	=	$	152,185.20
6.0	ac	Airport	@	$	13,891.00	/AC	=	$	83,346.00
3.7	ac	Industrial	@	$	35,000.00	/AC	=	$	129,500.00
24.6	ac	Crop Damage	@	$	800.00	/AC	=	$	19,680.00
							Subtotal	$	384,711.20
Easement Preparation & Negotiations (73 parcels @ $2,000 /parcel)								$	146,000.00
							Total	**$**	**530,711.20**

Route 2 - Illinois Route 50 Easement Costs

5.1	ac	Agricultural	@	$	8,182.00	/AC	=	$	41,728.20
0.0	ac	Airport	@	$	13,891.00	/AC	=	$	-
3.7	ac	Industrial	@	$	35,000.00	/AC	=	$	129,500.00
5.1	ac	Crop Damage	@	$	800.00	/AC	=	$	4,080.00
							Subtotal	$	175,308.20
Easement Preparation & Negotiations (10 parcels @ $2,000 /parcel)								$	20,000.00
							Total	**$**	**195,308.20**

The method for evaluating the properties is discussed in Section VII, D of the report.

The crop damages per acre was calculated using 1.5 times the average yearly crop yield and price per bushel for corn from 2005-2009 for Will County as compiled by the Illinois Department of Agriculture. Corn yielded more per acre in this time period that was used that as a basis for the crop damage costs.

Regarding utility permit fees, Route 5 would require a utility permit from Will County to place the water main in the highway right-of-way (ROW). The fee would be $950. There would be no highway ROW utilized in Kankakee County for this route, so no permit fees would apply. For Route 2, there would not be any utility permit fee to place the water main in Illinois Route 50. IDOT does not require a permit fee for utility permits.

As shown in Table 17, HDPE pipe is the most expensive construction alternative for any of the routes or flow conditions. Ductile iron is the next most expensive with PVC being the least cost alternative. The difference in construction costs between ductile iron and PVC decreases as the flow rates and corresponding design pipe sizes increase.

Route 5A construction costs are the lowest; however, as discussed below it has hydraulic limitations as compared to Route 2 and Route 5 alternatives. For the same flow capacity, a main running roughly parallel to the existing 20 in. main from pump station at Manteno to the intersection of 8000 N Rd. and 7000 E Rd. would be required. At this intersection, the new main to University Park would tie in. Since this new main would be 24 in., 30 in, or 36 in. size the existing 20 in. main would not have adequate hydraulic capacity. To be equivalent the following main size with a length of 20,600 feet would have to be constructed:

Main Size to University Park	Parallel Equivalent Pipes
24 in.	20 in. and 18 in.
30 in.	20 in. and 24 in.
36 in.	20 in. and 30 in.

From this analysis, the future construction cost for a parallel ductile iron water main 20,600 feet long required to reach hydraulic equivalence can be calculated:

Future Parallel Main Size	Cost per Foot	Length, Ft.	Total Cost
18 in.	$115	20,600	$2,369,000
24 in.	$145	20,600	$2,987,000
30 in.	$170	20,600	$3,502,000

VII. PUMPING STATIONS

Currently there are two pumping stations at Illinois Diversatech at Manteno, which are owned and operated by Aqua Illinois. The location map for the two pump stations is shown in Exhibit 2 in the Appendix. Both pump stations pump water from the 3 MG ground storage tank. Booster Pump Station No. 1 pumps the water to the Village of Grant Park. This pump station has three pumps rated at 700 gpm each. Booster Pump Station No. 2 pumps water to the Village of Manteno. This pump station has two pumps rated at 2,400 gpm each, and there is a room for an additional pump.

One option to consider for pumping water to University Park through the proposed transmission main would be to utilize Booster Station No. 2 for pumping into the new transmission main. In this option, the Village of Manteno would be connected to Booster Station No. 1, which would then serve both Manteno and Grant Park. Booster Station No. 1, with a firm capacity of 1,400 gpm would appear to have adequate capacity for both communities without any upgrades. Control valves would be needed for the elevated tanks in Manteno to prevent these tank(s) from overflowing during the times Grant Park's elevated tank(s) are filling.

With the option of utilizing Booster Station No. 2 to pump solely into the new transmission main, a third identical pump would be added to give the pump station a firm pumping capacity, with one pump out of service, of 4,800 gpm. Pump and system curves have been developed to evaluate the performance of the existing pumps connected to the new main. These pumps and system curves, along with pump efficiencies, for 24 in. and 30 in. mains are shown in Figures 10 through 13 in the Appendix. The following Table 47 summarizes the operating conditions for constant speed operation of the pumps for the two pipeline scenarios.

TABLE 47
BOOSTER STATION NO. 2
EXISTING PUMP OPERATION
WITH PROPOSED PIPELINE TO UNIVERSITY PARK

Pipeline Size in.	One Pump Operation		Two Parallel Pumps Operation	
	Capacity, gpm	Eff. %	Capacity, gpm	Eff. %
24 in.	2,750 gpm	85%	3,700 gpm	77%
30 in.	3,150 gpm	85%	5,000 gpm	82%

From the above Table 47, it can be determined that one of the existing pumps in operation with either of the pipelines can pump the current average day pumping rate of 1,400 gpm for University Park. Two pumps in parallel operation can pump the current maximum day pumping rate of 3,760 gpm for University Park. The pumping efficiencies are very good for both pipeline sizes and pump operations.

As the demand in University Park grows, or additional communities are served from the pipeline, Booster Station No. 2 would need to be supplemented with an additional booster pump station in parallel operation. With the pipeline designed at a flow rate corresponding to 5 fps, the only pump stations required for the pipeline would be located at Illinois Diversatech. In this case, the pipeline pressures at Illinois Diversatech would not be excessive.

The use of Booster Station No. 2 with the Route 5A pipeline has also been considered. In this alternative 20,600 ft. of the existing 20 in. main to Grant park is utilized for the pipeline to University Park. Since a larger main is proposed for the long term needs of the study area, the 20 in. main would reduce the pumping capacity for a given pump. Also, the demand of Grant Park would be added to the pipeline. The use of the existing pumps in Booster Station No. 2 may not have adequate capacity. In this scenario, Booster Station No. 1 would be reconnected to serve the Village of Manteno. Booster Station No. 2 would be reconnected to serve University Park and Grant Park. A pressure control valve would be installed on the 20 in. main east of the connection point for the new transmission main. This is needed because the main to Grant Park east of this point, will be operated at a lower pressure than the pipeline to University Park.

Pump and system curves have been developed to evaluate the performance of the existing pumps in Booster Station No. 2 connected to the 20 in. main in series combination with the proposed 24 in. main or 30 in. main. These pump and system curves along with the pump efficiencies for the two pipelines are shown in Figures 14 through 17 in the Appendix. The following Table 48 summarizes the operating conditions of the pumps for the two pipeline scenarios.

TABLE 48
BOOSTER STATION NO. 2
EXISTING PUMP OPERATION
WITH EXISTING 20 IN. MAIN AND PROPOSED PIPELINE

Proposed Pipeline Size in.	One Pump Operation		Two Parallel Pumps Operation	
	Capacity, gpm	Eff. %	Capacity, gpm	Eff. %
24 in.	2,550 gpm	84%	3,300 gpm	72%
30 in.	2,800 gpm	85%	3,800 gpm	78%

From the Table 48, it can be determined that one of the existing pumps in operation with either of the pipelines can pump the current average day pumping rate for the combination of University Park and Grant Park. Two pumps in parallel operation cannot pump the current maximum day for the combined demand. Higher capacity pumps would be required to meet the combined demands with these scenarios. Alternatively, a well pump in University Park could be used to supplement the peak demand, albeit with a reduction in water quality. A well in the industrial park could be used to supplement the peak demand there.

VIII. UTILITY PERMITS AND EASEMENT ACQUISITION

A. Acquisition Procedures

The following section discusses the proposed procedures for obtaining utility permits for installing the water main in County or State Highway Right-of-way (ROW), and obtaining easements across private property. Where feasible, the intent would be to install the water main in the highway ROW. Where this would not be possible because of the lack of ROW or restrictions on its use, the water main must be placed on permanent easements across private property. Temporary easements would be required where the adjacent ROW or permanent easement would not be wide enough for construction activities.

A tracking procedure will be implemented to track the progress of the ROW permit (utility permit) and easement acquisition. Once a water main route has been selected by Aqua Illinois, the ROW and property parcels to be traversed will be identified. Separate spreadsheets will be created for tracking the ROW permits and easements. The ROW permit tracking spreadsheet will track the following:

- Meetings with ROW permitting authority.
- Plan and permit application submittal to Aqua Illinois and ROW authority for review.
- Receipt of review comments.
- Revisions and resubmittal of the plans to the ROW authority.
- Receipt of permit.

For the easement acquisition spreadsheet, the following items will be tracked:

- Parcel Number
- Title Commitment
- Owner Information
- Legal Description and Easement Plat
- Easement Agreement Form Preparation
- Easement Agreement Form Approval by Aqua Illinois
- Negotiation Visits with the Owner
- Signed Easement Agreements
- Recording of Easement Agreements

Farnsworth Group, Inc. (FGI) will request that a title company provide a title commitment for each property to determine the owner of record. Two agreements are recommended for each property: the Easement Agreement and the Easement Amendment Agreement. The Easement Agreement would have the easement language acceptable to Aqua Illinois with a legal description and easement plat. The Easement Amendment Agreement would contain the financial terms for compensation of the owner for the easement, FGI recommends this document be kept confidential and proposes to negotiate with each land owner over the terms of this agreement independent of other land owners. The Easement Agreement would be recorded at the County, but the Easement Amendment Agreement would not be recorded. Both agreement forms would be approved by Aqua Illinois prior to beginning negotiations.

B. ICC Informational Packet

Prior to start of easement negotiations, FGI will assist Aqua Illinois in the development of an Illinois Commerce Commission (ICC) Informational Packet using the following information as required within Section 300.20 of the Administrative Code, Title 83:

> Prior to any public utility or its agent initiating contact with any landowner (the record owner of the land as disclosed by the records of the Tax Collector of the county wherein the land is located) to negotiate the acquisition of a land right-of-way easement, it shall file with the Illinois Commerce Commission an informational packet consisting of, but not necessarily limited to:
>
> - A brief description of the purpose of the project
> - Type of facility proposed to be constructed
> - Size of site or width of right-of-way being sought
> - Its expected origin and terminus points

FGI as utility representative will follow the procedures as outlined with the ICC Administrative Code Section 300.30 Negotiation of the Acquisition of a Land Right-of-Way Easements:

1. At least 14 days prior to the utility initiating telephone or personal contact with the landowner for the purposes of negotiating the acquisition of a land right-of-way easement, the utility representative shall send the landowner a letter by certified mail return receipt requested containing the information set forth below together with the "Statement of Information from the Illinois Commerce Commission Concerning Acquisition of Rights-of-Way by Illinois Utilities".

2. The utility representative shall keep and maintain a permanent record of letters sent in compliance with this Section.

3. The letter sent by the utility representative shall be on that representative's letterhead or on the letterhead of the utility and shall clearly set forth:

   a) The identity, address and telephone number of the utility representative;

   b) The identity of the utility attempting to acquire the land or land rights;

   c) The general purpose of the proposed project;

   d) The type of facility to be constructed;

   e) The general description of the land or land rights the utility seeks to acquire and the type of structures, if any, which the utility seeks to build;

   f) A statement that the utility or its representative seeks to negotiate with the landowner to arrive at a fair and reasonable agreement for such land or land rights; and

g) An invitation to the landowner to contact the utility representative to arrange a mutually agreeable time

4. If the landowner does not contact the utility representative within two weeks of the mailing of the original letter, that representative may then contact the landowner to attempt to establish a mutually convenient time and date for a meeting to discuss the matter.

5. Each utility representative shall carry with him/her and show to every landowner contacted an identification card showing the name and address of the contacting person, his/her employer, and a recent picture of such person. The contacting person shall leave his/her telephone number with the landowner.

6. Upon the initial personal contact with the landowner, each utility representative shall be prepared to discuss the project for which a land right-of-way is sought in detail, and more specifically inform and advise the landowner in the manner stated, of the following:

   a) By oral statement concerning the reason for the contact, i.e., general purpose of the proposed project, type of facilities to be constructed.

   b) Provide technical information and data surrounding the proposed project. This should include, amongst other things, to the extent then known to utility, a written statement outlining briefly the purpose of the project, a small scale map and sketches indicating type(s) of facility, approximate location of facilities, compensation and basis for compensation and, if applicable, type of structures and amount (length and width) of the land right-of-way deemed necessary. This information shall be left with the landowner for review, along with any agreement or contract proposed by the utility.

C. <u>Easement Negotiations</u>

The following is a description for potential negotiable items in the easement negotiations:

1. FGI recommends Aqua Illinois provide monetary compensation based on acreage required and property values per acre. A minimum property value based on the estimate of the fair value would be the initial offer in the negotiations. These values are discussed below. It is proposed that Aqua Illinois would provide FGI authority to negotiate easements up to a certain percentage over the estimated property value.

2. An easement width of 20 to 30 ft. is proposed. A width of 30 ft. is proposed if a future main is being provided for. FGI should have the latitude to request additional easement width if this easement width is needed in order to reroute the main. This additional easement width would usually only be needed in cases where a major physical obstacle was encountered (i.e. trees, sign, septic system).

3. The initial Easement Agreement will indicate there will be no compensation for the removal of trees, shrubs, bushes, etc. FGI recognizes that in order to acquire easements from homeowner sites, it will be necessary to replace, within reason, all

landscaping removed during construction. FGI requests to have the authority to negotiate language into the easement stating that. FGI also recognizes that some larger trees may need to be removed and no comparable replacement tree will be available.

4. Aqua Illinois should reimburse property owners, or their designated agent, for all loss of crops resulting from the installation of water main and any and all subsequent times Aqua Illinois disturbs the easement surface or damages growing crops. This will include crops lost directly as a result of construction, as well as those crops not planted at the request of the Company in anticipation of future construction. FGI recommends that the Owners, or their designated agent, will supply Aqua Illinois with crop yields from the remainder of the land tract, as well as price per bushel received for the sale of said crop, and the Company will determine acreage lost due to construction activities. FGI recommends that Aqua Illinois pay crop damages based on the following:

   a) Crop year in which installation or disturbance occurs, 100% damages.
   b) Crop year following installation or disturbance, 50% based on current years yields.

5. FGI recommends that compensation for crop damages be fixed and non-negotiable. The intent is to treat all landowners consistently with respect to this compensation. We will suggest Aqua Illinois compensate for crop damage even if the landowner opts to put the land in set-aside acreage. FGI can make the landowner aware of this fact during negotiations. The reason for taking this approach is that it is worth the compensation to not have to contend with large amounts of corn and beans residue during construction. Compensation will be based on the yield and price received from the remainder of the field.

6. Aqua Illinois can authorize FGI to negotiate to deep rip soil to eliminate excessive soil compaction caused from construction activity. Aqua Illinois will pay Grantor to do this deep rip or Aqua Illinois can hire a contractor to perform this work.

7. FGI recommends that Aqua Illinois allows FGI the authority to negotiate for the application of agricultural lime or lime slurry within the tillable areas disturbed during the installation of the water main at a rate equal to that of the most recent application of the same. Application shall be coordinated with landowner to minimize impact on farming operations.

D. Property Evaluation

In easement negotiations it is important to determine fair property values. In an effort to evaluate fair land parcel values, FGI researched land sales for agricultural, residential, and commercial/industrial properties in Kankakee and Will Counties near the proposed routes from 01/01/11 to 10/31/12 by property type. Research was also used to determine the sales prices for parcels of properties in the South Suburban Airport inaugural footprint.

The average fair value for agricultural property value was calculated by taking the sale price of each property. This value was multiplied by the ratio of assessed land value to the total assessed property value, and, then dividing by the number of acres. Using this methodology the average price per acre for agricultural property was $8,182/acre. FGI recommendation for the minimum agricultural easement valuation for the water main is $6,000/acre.

The residential and commercial/industrial property values were calculated using the same methodology. Using this methodology, the average price per acre for residential properties was $20,921/acre. FGI recommendation for the minimum residential easement valuation is $10,000/acre. The per acre values for commercial/industrial property were more variable than the residential and agricultural properties with valuations ranging from $27,533 to $171,136 per acre. The average value was $87,018 per acre. FGI recommendation would be to use $20,000 per acre as a minimum valuation for easement negotiations.

The average valuation for land in the South Suburban Airport (SSA) Inaugural Footprint was determined using data from IDOT on the purchase price of properties for the airport. The average per acre price for properties purchased by IDOT is $13,891/acre. FGI recommendation would be to use $10,000 per acre as a minimum valuation for easement negotiations for the SSA area.

IX. RECOMMENDATIONS

A. Water Supply Alternatives

A water transmission main extending from Aqua Illinois' system in Illinois Diversatech in Manteno to University Park is the recommended alternative for providing treated water to the study area in this report. The water supply would be from the Kankakee River and treated at Aqua Illinois' lime softening plant in Kankakee. The other alternatives investigated in this report include:

- Ground water supply and treatment in University Park
- Lake Michigan water supply

The ground water supply and treatment alternative was estimated to be more costly than any of the water main alternatives. Moreover, the capacity of the ground water aquifer in Will County is limited and would need to be supplemented with an outside source of water at some time in the future. As demands on the aquifer increase, the recharge rate will not keep up with the demand. Water levels in the aquifer will drop, causing diminished well capacities over time. The Kankakee River is an ample and reliable source of water that could supplement the diminishing ground water supply.

The alternative of obtaining water from Lake Michigan was deemed to be infeasible. For the long term needs of the area, the source of the Lake Michigan water needs to be the City of Chicago. Due to the distance involved, this alternative would be cost prohibitive. Moreover, the political difficulties of getting approval of this source would be considerable, if not insurmountable.

B. Water Main Routes

Five water main routes were investigated in this report as illustrated in Figure 9 of the Appendix:

- County Highway 19 (Center Road)
- Interstate 57
- Illinois Route 50
- Canadian National Railroad
- County Highway 10 (Will Center Road)

Of the five routes, County Highway 10 and Illinois Route 50 were considered the most feasible. The recommended route of these two alternatives is County Highway 10. This route is less developed since Illinois Route 50 crosses through the Villages of Peotone and Monee. Some of the construction difficulties that would be encountered are listed in Exhibit 3 of the Appendix. Due to the impact on the communities in crossing through the business and residential areas, negative political fallout would occur for Aqua Illinois. Even though the construction cost estimate for this route appears to be less in this study. Unforeseen, conditions could drive these costs up.

Route 5, the County Highway 10 water main route, has the disadvantage of requiring more easements than Route 2, the Illinois Route 50 water main route. This will mean additional project costs for easement acquisitions, and potential project delays. The offering of fair market value compensation for the easement should mitigate any project delays. The advantage of a permanent easement over a ROW permit is that the owner of private property couldn't require Aqua Illinois to move the water main in the future with no compensation. The State or County could require Aqua Illinois to move the water main if it is located in highway ROW, at its own costs.

To save on initial costs, a variation of Route 5 could be selected, known as Route 5A in this report. This route utilizes a portion of the existing 20 in. main. As discussed above, this alternative would reduce the hydraulic capacity of the pipeline to University Park but could handle current needs of University Park and Grant Park with larger pumps or the use of a well at University Park for peak demand periods.

C. Water Main Size and Type of Material

The minimum recommended size of the water transmission main from Illinois Diversatech to University Park is 24 in. This is based on the optimum peak water transmission velocity of 5 fps. This size main under this condition would be able to provide 7,200 gpm to the study area under peak pumping conditions. This would meet the peak projected demand of University Park and the anticipated growth in the region in the year 2033. Flows resulting in velocities significantly greater than 5 fps in the pipeline would result in excessive operating pressures at Manteno without the construction of additional booster pump stations along the water main route. A 24 in. main would make the use of Booster Pump Station No. 2 (EFI Pump Station) feasible for the near term. A larger size pipeline, such as 30 in., may be of interest to Aqua Illinois for its greater flow capacity and potential to serve more growth in the area.

The preferred material for the pipeline is ductile iron. This is based on the strength of the material and its resistance to permeation as discussed above. However, a PVC transmission main is a viable alternative when considering its construction cost advantage. The expected failure rate and life expectancy of PVC is expected to be the same as ductile iron. For these reasons, PVC has not been ruled out. Because of the high construction costs, HDPE has been ruled out for the water main material.